Socio-economic factors that constrain or facilitate adoption of soil carbon enhancing land management practices among households in Ethiopia and Kenya

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Outline

- Introduction
- Objective
- Material and methods
  - Review
  - Analysis of WOCAT and CIAT led practices data
- Definition and concepts
- Results
  - Review results
  - Analytical results
- Conclusion
- recommendation

Introduction

- In areas where farming is a primary activity land degradation through soil and nutrient loss is common
- Erosion and nutrient depletion leads to unproductive land parcels
- To counter this effects, farmers invest in agricultural and sustainable land management (SLM) practices
- Evidence indicates that SLM practices enhances soil carbon

Introduction

But what is the importance of enhancing soil carbon?

Soil carbon influences soil properties that ensures sustainability of all soil (and ecosystem) functions

This, in turn improves productivity (crop and livestock), income and food security

Introduction

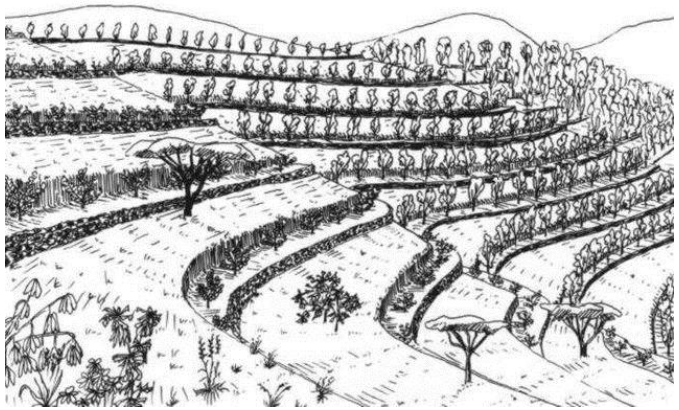
- However, the adoption of soil carbon enhancing practices in East Africa is still limited (e.g., Adimassu et al., 2014; Koirala et al., 2015)

- Different factors (i.e., socio-economic, biophysical, and institutional etc.) have been shown to affect adoption decisions at the farm level

- Guided by existing literature, we review factors that constrain or facilitate adoption of soil carbon enhancing practices by farmers in East Africa (Kenya & Ethiopia)

Objective

- To analyse and synthesize existing knowledge from past studies in order to identify the socio-economic factors that constrains or facilitate the adoption of agricultural management activities that enhances carbon sequestration



Materials and methods: Review

- A structured literature review approach of publications on adoption of agricultural and SLM practices that increase soil carbon

- We define key concepts, followed by a review and synthesis

- For the review a database containing various socio-economic factors available in the literature was created in MICROSOFT Excel then summarized in word

Definition of terms & concepts

- **Carbon sequestration** is the actual transfer and secure storage of atmospheric CO2 into the soils pools, comprising of soil organic matter (SOC) and soil inorganic matter (SIC)

- **Agricultural management** practices "set of management practices that reduce the potentially negative impact of agricultural operations"

- **Sustainable land management (SLM) practices** refers to any set of comprehensive land management practices, that has a potential of making a significant difference – in terms of reducing land degradation and improving land productivity – in the near future and in the long term

- **Adoption** is degree of use of a new technology in the long-run equilibrium when the farmer has full information about the new technology and its potential".

Materials and methods: Analysis

- Data from the WOCAT and CIAT-best bet practices database were used

- We used agglomerative hierarchical analysis in clustering the households into three homogenous groups (HGs)

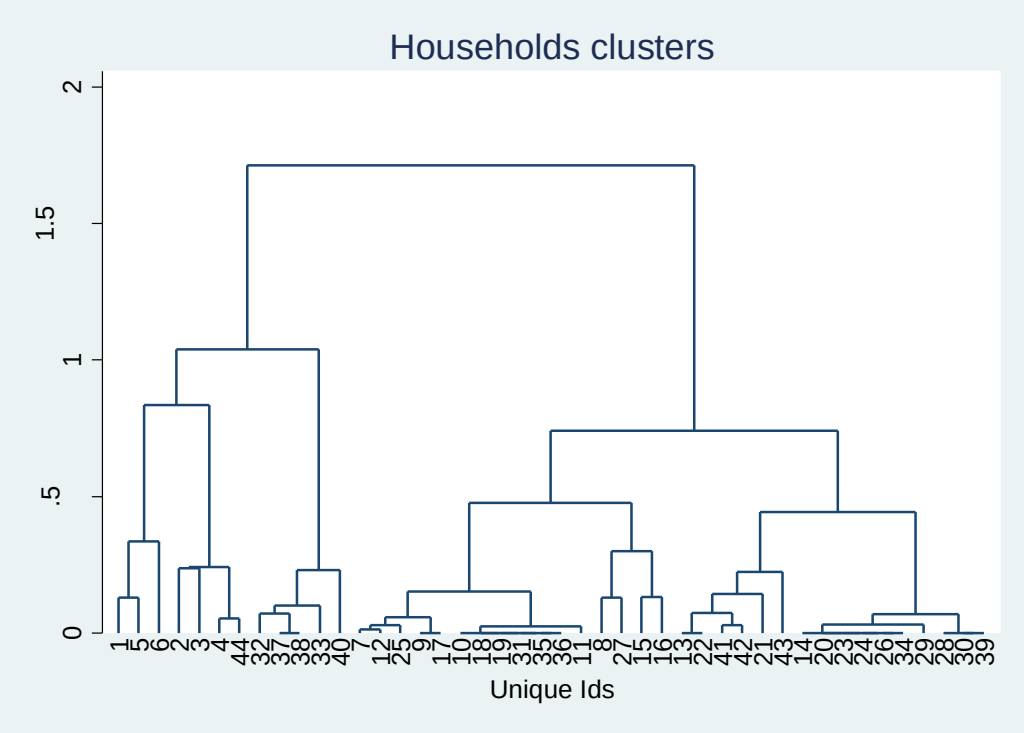
- The clustering sought to maximize between-cluster variances and to minimize-within cluster

- We refer to the three group types as farmers who had adopted:

(i) crop and forage enhancing practices,'

(ii) water harvesting and/or water drainage enhancing practices

(iii) Carbon sequestration enhancing practices



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Results: *from review*

	Ethiopia	Kenya
No. of papers reviewed	90	54
Average sample size	350	948
Study sites	Tigray and Amhara (North and North West)	Coast, Western, Nyanza, Central, Eastern and Rift Valley
Common practices	Minimum tillage, intercropping, tree planting, farm yard manure, mixed farming, compost, soil/stone bunds	Terracing, minimum tillage, intercropping, farmyard manure, fertilizer, mixed farming, and tree planting
Method of analysis	Probit, Logit, Tobit (90%) Descriptive and inferential methods (OLS, correlation, chi-square, and ANOVA) 10%	Probit, Logit, Tobit (30%) Descriptive and inferential methods (OLS, correlation, chi-square, and ANOVA) 52% CBA and partial budgeting (8%)
Main determinants of adoption	Socio-economic, farm level and institutional factors	Socio-economic, farm specific, physical and institutional factors

Results: *review*

- Different factors (socio, plot farm, institutional etc.) differs in terms of their effect on adoption

	Effect	
Factors	Ethiopia	Kenya
Age	Old **(–ve)** Young (+ve) on soil bund & conservation tillage	Old **(+ve)** fertilizer; Young (+ve) i seeds & cover crops
Gender	Male **(–ve)** cover crops, Male **(+ve)** fertilizer & manure Female **(-ve)** fertilizer & manure	Male **(–ve**) cover crops Male **(+ve)** fertilizer & manure Female **(-ve)** fertilizer & manure
Household size	**(+ve)** manure and compost (-ve) fertilizer	**(+ve)** manure and compost, **(-ve)** fertilizer
Income (including off-farm income)	**(+ve)** soil fertility, fertilizer, and soil erosion control	**(+ve)** soil fertility, fertilizer, and soil erosion control
Off-farm income	**(-ve)** labor intensive practices (e.g soil bund)	**(-ve)** labor intensive practices (eg use of manure)
Experience and farm size	**(+ve)** tree planting, soil erosion control, fertilizer use	**(+ve)** tree planting, soil erosion control, fertilizer use

Results: *review*

	Effect	
Factors	Ethiopia	Kenya
credit	**(+ve)** on soil conservation, agroforestry, and minimum tillage	**(+ve)** intercropping, soil erosion prevention, and fertilizer
Education	**(+ve)** minimum tillage, agroforestry, mixed farming, intercropping	**(+ve)** minimum tillage, agroforestry, mixed farming, intercropping
Extension services	**(+ve)** fertilizer & manure, intercropping, soil bund terraces, and minimum tillage	**(+ve)** fertilizer & manure, intercropping, agro-forestry, terraces, and minimum tillage
Market access	Vary depending on the distance and state of infrastructure	**(-ve)** fertilizer, terraces and strip cultivation
Social capital (groups and networks)	**(+ve)** fertilizer, manure and soil erosion control	**(+ve)** fertilizer, manure and soil erosion control
Land size (diminishing)	**(-ve)** agro-forestry, soil erosion control, intercropping, and minimum tillage; **(+ve)** crop diversification	**(-ve)** agro-forestry, soil erosion control, intercropping, and minimum tillage; **(+ve)** crop diversification
Security of land tenure	**(+ve)** tree planting, soil erosion control, fertilizer use	**(+ve)** tree planting, soil erosion control, fertilizer use

Results: *Analytical (Ethiopia)*

- Most households (86%) are extensive land users.
- Decisions on SLM practices are made jointly by male and female in most households
- Average land size is >2ha with a mixed market orientation
- 60% of the households are in the middle income category
- More than 50% have off-farm income (>100US$), and have moderate access to technical assistance
- Generally, benefits vs costs can be evaluated as positive in the short run. However costs of labor are higher than that of inputs (labor maintenance-$230; input maintenance -$190)

Results: *Analytical (Kenya)*

- Most households have a moderate knowledge of SLM technologies
- Men are the main decision makers
- 52% of farmers are in the middle income
- 68% of farmers have an off farm income of <100$ (and only 20% with US$100-500)
- Adoption of SLM practices is mainly attributed to cheap labor while non-adoption to diminishing land size.
- The benefits and costs, both in the short and long run are weighed as positive (by 70% & 92% of households respectively); which could be an incentive for adoption.

Results and discussions cont.'

Summary of regression results (Kenya)

Variable	Significance	Implication
Off-farm income	Neg. (Middle income category 100-500$)	Low income households prioritize needs before engaging in income related activities
Technical assistance	Neg. (Poor, moderate, good)	Source of technical assistance is unaware of modern SLM techniques or is inclined towards improving quality of production
Benefits vs maintenance costs	Neg. (Short run)	Households are likely to adopt or use SLM techniques that would bring instant returns
Market Orientation	Pos. (Mixed and commercial)	Households with a commercial orientation seek to maximize output hence they are likely to invest in practices that would improve output/yields
Gender	Pos. (Joint decisions)	Joint decisions lead to effectual management of resources, minimizing costs and wastage of available resources thus encouraging adoption

Results and discussions cont.'

Summary of regression results (Ethiopia)

Variable	Significance	Implication
Knowledge of technology use	Neg. (Low)	Lack of knowledge on technologies used acts as a hindrance to adoption
Planting as an establishment activity	Neg.	Plants are prioritized as food crops rather than as a conservation measure
Maintenance cost of inputs	Pos.	Maintenance cost of inputs is relatively cheap hence easily afforded
Market Orientation	Neg. (Mixed)	Focus on production is more on meeting food needs, and commercialization dependent on surplus
Benefits vs establishment cost	Pos. (Long run)	SLM practices have higher benefits in the long run hence farmers are willing to take the risk of waiting
Cheap labor	Pos.	Availability of labor is an incentive for adoption of SLM techniques
Reduced cultivation land	Neg.	Households have smaller land sizes that is only sufficient to sustain their livelihoods

Conclusions

- Socio-economic factors have a varied influence adoption of SLM practices that enhance soil carbon depending on the nature of technology

- The differences or similarity in the effects of different factors on technology adoption suggest that the farming context need

- The factors that affect farmer incentive to invest in soil carbon enhancing practices are related to those conditions that affect the net returns

- Most farmers are sensitive to net returns to their labor or financial investment

Conclusions

- External factors can affect farmers decision to invest on soil carbon enhancing practice indirectly

- Effectiveness of soil carbon enhancing practices depends on how well institutions can provide technical support

Recommendations

- The policy or strategy formulation framework needs to incorporate the fact that adoption is constrained or enabled by certain factors which should be improved to facilitate increased adoption.

  - There is need for improving farmers capacity to invest in carbon enhancing practices
  - There is need to create stable and secure land tenure systems in East Africa
  - There is need to create enabling conditions to enhance adoption of soil carbon enhancing practices

Thank you

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